Finite Element Method

Student’s Name

Institution

Date

**Integrate by Part in 2D**

In mathematical analysis, integration by parts is one of the processes, which are used to find the integral of a product. It is a function term used for integral derivative and antiderivative. According to Rebman (2016), it is usually used for the transformation of the antiderivative of a product of specific functions to an antiderivative solution, which can easily be found. However, the integration parts are used or ruled in two dimensions. The rules of integrated parts can be derived from one simple sine by integrating the product rules of differentiation (Rebman, 2016). The two dimensions are situated in the polar coordinates and therefore, the first coordinate has n = → nr. However, the integral part for 1D is derived in a simple way in a single straight line while for 2D is derived in a double line. This shows a clear distinction between 1D and 2D integrates parts.

The integral parts are derived from a powerful formula for integration. The formula starts with (*f*(*x*)*g*(*x*))=*f*(*x*)*g*(*x*)+*f*(*x*)*g*(*x*). And therefore, when both sides are integrated the formula gives get f(x)g(x)= f(x)g (x)dx+ f. It is also stated that when working with the formula, it is important not to include constant of the integration on the left side of the formula. It is because the integral on the right will always have the integration constant. However, when f(x)g(x)dx is solved we are likely to get  f(x)g(x)dx=f(x)g(x)-  f(x)g(x)dx, which is the integral dimension one, or know as 1D. The integral part formula is therefore, expressed as u=f(x) du=f (x)dx dv=g (x)dx v=g(x). The integral by parts selectively choose *u*, *dv* and then the formula is applied. The formula for integration by parts is, therefore, applied by using u and dv by replacing letters for easy computation. In computation of the integral by parts, u = f(x) du = f, (x) dx dv = g, (x) dx v = g (x). After replacement, the formula, therefore, becomes as indicated below. It is, therefore, appropriate to states that the formula for integrating by parts in 2D is as indicated by below.



**Apply divergence theorem**

The divergence theorem has made it possible for the physical law to be written in differential form. The divergence theorem is used to evaluate a vector surface, which exists over a closed surface. It can also be used to estimate or calculate triple integrals by changing them into surface integrals. According to Lemay (2017), this is based on the finding of a vector whose divergence obtained to be equal to a given function. The divergence theorem, therefore, hosts physical laws, which are written in the differential form, whereby one quantity is divergence to another quantity (Lemay, 2017). The divergence theorem is, therefore, is applied to solving problems, which relates to vector and the surface area to determine the surface area of an object and then compare the number of different objects.

 The divergence theorem is, therefore, given as s (3xi+2yj). dA= R 5dV = 5X ( the volume of the sphere) = 180. In short, the divergence theorem should be used when evaluating the vector surface integral of a closed surface. In reality, it would faster and easier to calculate the triple integral. In reality, the divergence theorem is basically used to calculate triple integrals, which would be difficult to calculate or set up. In this case, it is evidence that divergence theorem is used to compute the surface area of a closed surface of an object. It also involves several steps like finding S and n for it to be applied well to obtain the integral surface of a close object and the unit normal vector of an object.

# References

Lemay, G. (2017). Divergence Theorem: Definition, Applications & Examples.

*https://study.com/academy/lesson/divergence-theorem-definition-applications-examples.html*, 2-15.

Rebman, P. (2016). Integration by parts in 2D. *International Journal of Mathematics*, 2-15.